



**CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY**

Name(s) Virginia F. Hsiao	Project Number S1999
Project Title WiFi? Evaluating the Effects of Human Radiofrequency Waves on Raphanus sativus Seeds	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals As the use of technology increases in modern society, an increased exposure to human radiofrequency (RF) waves emanated by these devices results. Even with research, scientists remain uncertain of the effects. The goal of this project is to evaluate the effects of relatively high human RF waves (2.4 Ghz and 5.8 Ghz) on Raphanus sativus seed germination, quantified through changes in growth, biochemical production, and other signs indicative of potential radiation damage.</p> <p>Methods/Materials Thirty similarly sized Raphanus sativus seeds were acquired and separated into three groups (control, 2.4 Ghz, and 5.8 Ghz). 2.4 Gigahertz and 5.8 Gigahertz directional wireless antennas were directed at respective seed samples. Root growth and shoot growth were recorded daily. At the conclusion of the project, three samples from each group were selected for chlorophyll quantification and submerged in 5 mL of ethanol. Eight hours later, samples were analyzed in the spectrophotometer at the lambdamax of 430 nm and 662 nm.</p> <p>Results T-tests indicated that the root growth of both the 2.4 GHz and the 5.8 GHz were not statistically significant in comparison to the control. Conversely, T-tests found the comparisons of the shoot growth between the control and 5.8 GHz (P= 0.00004) as well as the control and 2.4 GHz (P=0.0002) to be statistically significant. Following spectrophotometer analysis, it was determined that the control had the most chlorophyll present, as the average absorbance unit doubled that of the 5.8 GHz sample.</p> <p>Conclusions/Discussion This study suggests that there is an effect of human RF radiation on the germination of Raphanus sativus radish seeds. As T-tests indicated the statistical insignificance of the root growth, such growth can be dismissed as similar structural growth. However, the disparity in chlorophyll production indicated that while systemic growth remained similar, biochemical production differed. As the production of chlorophyll decreased as the radiation exposure increased, there is an association between the radiation of radio waves and changes on the biochemical level. Thus, human RF waves, over time, do affect Raphanus sativus plants, leading to drastic differences in biochemical that could potentially lead to the demise of the plant.</p>	
Summary Statement My experiment seeks to elucidate uncertainties regarding the effects of RF radiation on developing cells and found that while systemic growth of affected samples remained similar, biochemical changes characterized RF exposure.	
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